CLAIMS

What Is Claimed Is:

1. A method of identifying a defect in a substrate, the method comprising:

imaging an area of the substrate with and without application of heat, to obtain a hot image and a cold image respectively;

comparing at least a portion of the hot image with a corresponding portion of the cold image; and

providing an indication about a suspected defect in response to the comparison.

2. The method of Claim 1 further comprising, prior to said identifying:

repeating said imaging and said comparing; and

averaging said result from each comparing to obtain an averaged comparison result;

wherein said identifying uses said averaged comparison result.

3. The method of Claim 1 further comprising, during said identifying:

checking if said result differs significantly relative to previous results of said comparing.

4. The method of Claim 1 further comprising, during said identifying:

checking if said result exceeds a predetermined value.

5. The method of Claim 4 wherein:

said predetermined value is responsive to a type of material expected to be present, and size and geometry of a feature to be fabricated.

6. The method of Claim 1 further comprising:

adjusting intensities in said hot image to ensure that a majority of adjusted intensities are at least substantially same as intensities at corresponding locations in the cold image.

7. The method of Claim 6 further comprising, during said comparing:

subtracting adjusted intensities for the hot image from intensities at corresponding locations in the cold image, thereby to obtain said results of said comparing for each location.

8. The method of Claim 1 further comprising, during said comparing:

adjusting intensities in at least one of said hot and cold images to ensure that a majority of adjusted intensities are at least substantially same as intensities at corresponding locations in the other of said hot and cold images.

9. The method of Claim 1 further comprising:

adjusting gain and offset of said intensities.

10. The method of Claim 1 further comprising, during said comparing:

normalizing intensities in each of said hot and cold images; and

subtracting normalized intensities in one of said hot and cold images from normalized intensities in the other of said hot and cold images.

11. The method of Claim 1 further comprising, during said comparing:

subtracting intensities in said cold image from intensities in said hot image, thereby to obtain a difference in intensities for each location.

12. The method of Claim 1 further comprising:

repeatedly applying and not applying heat to the same area; and

imaging the same area after each repeated applying and after each repeated not applying

13. The method of Claim 12 wherein:

said hot image is imaged during applying heat.

14. The method of Claim 12 wherein:

said hot image is imaged immediately after said applying heat; and

said cold image is imaged subsequent to imaging of said hot image but prior to applying heat again.

15. The method of Claim 12 wherein:

said hot image is imaged immediately after said applying heat; and

said cold image is imaged immediately prior to said applying heat.

16. The method of Claim 12 wherein:

heat is applied by a heating beam; and

a probe beam illuminates said area at least during imaging, said probe beam having a different wavelength than said heating beam.

17. The method of Claim 12 wherein:

heat is applied by a laser beam; and

said laser beam also illuminates said area at least during imaging, said laser beam having a lower intensity during illumination for imaging than during applying of heat.

18. The method of Claim 1 wherein:

said imaging uses a plurality of sensors located along a straight line.

19. The method of Claim 18 further comprising:

repeating said imaging along a plurality of lines parallel to said straight line;

wherein each line in said plurality of lines is separated from an adjacent line in said plurality of lines by a predetermined distance.

20. The method of Claim 1 wherein:

said imaging uses a plurality of sensors located in a two-dimensional plane.

21. The method of Claim 1 wherein a differential image is obtained from said comparing, the method further comprising:

repeating said imaging and said comparing in corresponding areas of a plurality of dies, to obtain a differential image for each die; and

making a die-to-die comparison of the differential images, to identify each defective location.

22. The method of Claim 21 wherein:

for each die a plurality of differential images are obtained and averaged to obtain an averaged differential image; and

the averaged differential images are compared to one another during said die-to-die comparison.

23. The method of Claim 1 wherein a differential image is obtained from said comparing, the method further comprising:

repeating said imaging and said comparing in a plurality of cells, to obtain a differential image for each cell; and

making a cell-to-cell comparison of the differential images, to identify each defective location.

24. The method of Claim 1 wherein:

during said imaging the hot image is obtained by simultaneously making a plurality of measurements in said area to obtain a corresponding plurality of pixels for the hot image and the cold image is obtained at a different time by simultaneously making another plurality of measurements in

said area to obtain another plurality of pixels for the cold image.

25. A method of identifying a defect in a substrate, the method comprising:

heating an area of said substrate with a heating beam;

imaging said area while heat is dissipating therefrom, thereby to obtain a hot image;

imaging said area either prior to said heating or after a majority of said heat is dissipated, thereby to obtain a cold image; and

comparing the hot image with the cold image to obtain a differential image;

repeating said heating, said imaging and said comparing; and

averaging results of said comparing at each location across all differential images, to obtain an averaged differential image; and

identifying a location as having said defect if a value in the averaged differential image at said location differs significantly relative to corresponding values at other locations.

26. The method of Claim 25 wherein:

said other locations are preselected to have one of: a type of material expected to be present, size and geometry of a feature to be fabricated.

27. An apparatus for identifying a defect in a substrate, the apparatus comprising:

a heating source, for heating an area of the substrate;

an illumination source, for illuminating the area being heated by the heating source;

a plurality of sensors, for obtaining a hot image and a cold image respectively of the area; and

a processor, for comparing at least a portion of the hot image with a corresponding portion of the cold image, and providing an indication about a suspected defect in response to the comparison.

28. The apparatus of Claim 27 wherein said processor receives a plurality of hot and cold images for said area, said processor being programmed to:

average results of said comparing to obtain an averaged comparison result; and

use said averaged comparison result to generate said indication.

29. The apparatus of Claim 27 further comprising a switching circuit coupled to the heating source and the plurality of sensors, the switching circuit being configured to automatically turn on and off the heating source at a first frequency that is half of a second frequency of imaging by the plurality of sensors.

30. The apparatus of Claim 29 wherein:

said switching circuit comprises an acousto-optic crystal.

31. The apparatus of Claim 29 wherein:

said switching circuit comprises an electro-optic crystal.

32. The apparatus of Claim 29 wherein:

said switching circuit comprises means for modulating electrical drive current to said laser.

33. The apparatus of Claim 29 wherein said processor receives a plurality of hot and cold images for said area, said processor being programmed to:

average results of said comparing at each location to obtain an averaged comparison result for each location; and

use said averaged comparison result during said identifying.

34. The apparatus of Claim 29 wherein said illumination source comprises an arc lamp.

35. The apparatus of Claim 29 wherein said illumination source comprises a laser.

36. The apparatus of Claim 29 wherein said plurality of sensors are located along a straight line.

37. The apparatus of Claim 29 wherein said plurality of sensors are located along a two dimensional plane, and are included in an area camera.

38. The apparatus of Claim 29 wherein said plurality of sensors are included in a CCD camera, said apparatus comprising said CCD camera.

39. An apparatus for identifying a defect in a substrate, the apparatus comprising:

a first source of electromagnetic radiation;

a second source of electromagnetic radiation, the second source being located relative to the first source to illuminate an area of the substrate to be illuminated by said first source;

a plurality of photodetectors sensitive to electromagnetic radiation from the second source; and

a switching circuit having a first line connected to said first source, and a second line connected to said plurality of sensors;

wherein the switching circuit supplies a first control signal on the first line to automatically turn on and off said first source at a first frequency;

wherein the switching circuit a second control signal on the second line to turn on and off the photodetectors at a second frequency, the second frequency being twice the first frequency;

wherein a first phase difference between turning on of the first source and a first turning on of the photodetectors immediately thereafter, is sufficiently small to ensure that the photodetectors capture a first image of said area while heat is dissipating therefrom; and

wherein a second phase difference between turning on of the first source and a second turning on of the photodetectors immediately after the first turning on is sufficiently large to ensure that said photodetectors capture a second image of said area after a majority of said heat is dissipated therefrom.

40. The apparatus of Claim 39 wherein:

the switching circuit has a third line connected to the second source of electromagnetic radiation; and

the switching circuit supplies a third control signal on the third line to turn on and off the second source at the second frequency.

41. The apparatus of Claim 39 wherein:

the switching circuit is decoupled from the second source of electromagnetic radiation.

42. The apparatus of Claim 39 further comprising:

a computer coupled to the plurality of photodetectors to receive therefrom each of the first image and the second image;

wherein said computer is programmed to compare said first image and said second image and to identify said area as being suspected of containing said defect based on a result of comparison.

43. The apparatus of Claim 39 wherein:

the switching circuit is coupled by a third line to the second source of electromagnetic radiation; and

the third line is deactivated.

44. The apparatus of Claim 39 wherein said plurality of photodetectors are located along a straight line.

45. The apparatus of Claim 39 wherein said plurality of photodetectors are located along a two dimensional plane, and are included in an area camera.

46. The apparatus of Claim 39 wherein said plurality of photodetectors are included in a CCD camera, said apparatus comprising said CCD camera.